COMMENSALISM BETWEEN *RANZOVIUS MOERENS* (REUTER) (HEMIPTERA: MIRIDAE) AND *HOLOLENA CURTA* (McCOOK) (ARANEIDA: AGELENIDAE).

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In the spring of 1966, small red mirids were observed inhabiting the webs of *Hololena curta* (McCook), one of the most common agelenid spiders in the Los Angeles area. The insects, identified as *Ranzovius moerens* (Reuter), could be found only on the webs in two hedges of mixed honeysuckle, *Lonicera japonica*, and trumpet flower, *Clytostoma callistegiodes* in San Marino, California. This was the first report of this insect being associated with spiders, and it is one of the few examples of spider-insect associations.

These spiders are funnel-web builders, and their webs form platforms as they come out of the hedge. This horizontal sheet of silk narrows as it extends back into the hedge and forms a funnel-shaped tube of webbing up to 3 inches long which serves as the retreat of the spider where it waits for prey to enter the web. The main sheet of silk varies from a 1 × 2 inch platform to one of 8 × 8 inches, according to the maturity of the spider. These are generally three to six feet above the ground. The webs are composed entirely of dry silk, having no adhesive qualities like those of some other spiders. Some of the larger webs of this agelenid have one or two additional platforms under the main one, the spider going to any platform to capture prey. These webs are typical of agelenid spiders in bushes (Gertsch, 1949), having a network of silk lines suspended above the platform in an irregular fashion which act as trip wires, causing insects that hit them to fall onto the platform of webbing. When the confused insect falls onto the platform, the spider rushes from its funnel to attack it.

The spiders have been observed in the hedge all year round, with the young emerging in April and May. They are shy in the day, remaining in the funnel unless prey is in the web, but at night they are almost invariably seen out on the webs.

The eggs of *R. moerens* were never observed, but, judging by the criteria of Davis (1955), the ovipositor with its saw-like teeth (Fig. 1 A-B) is fully developed for placing them in plant tissue rather than on the web surfaces or on spider prey.

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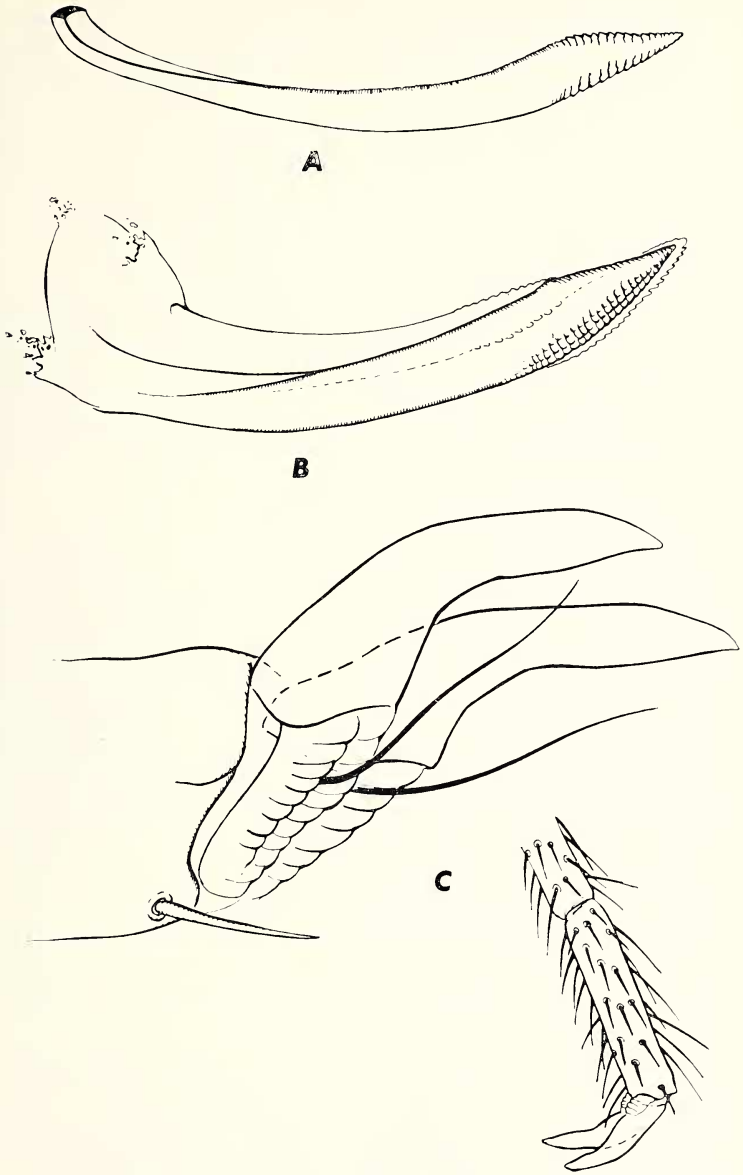

Fig. 1. A. Outer valvula of *Lygus lineolaris* ovipositor used to place eggs in plant tissue; B. Ovipositor of *R. moerens*; C. Hind tarsal claw of *R. moerens* showing ridged area and hooked versus extended position.

The first nymphs appeared in the webs in middle March (March 20, 1967, and March 18, 1968). Hatching must continue until June since large numbers of first instar nymphs were seen in the webs until that time.

The first adults were seen on May 29, 1967, and on May 3, 1968. At this time, all stages of nymphs and adults were seen on the webs concurrently. The adults were seen in the webs until September 10, 1967, and August 30, 1968. From one to as many as forty mirids occurred on a single web, depending on its size.

The mirids were active in the daylight hours, even on the hottest days, and walked or ran rapidly on the web. They appeared to move randomly over it, searching for food, and were found equally often in sun or shade. They were inactive at night, staying motionless in one place. This was possibly due to the disturbance caused by the spider being on the platform at night. The mirids were found on both sides of the web platform, and they walked and ran equally well either upright on the top of the web or inverted on the bottom. The tarsal claws (Fig. 1 C) are well adapted for this. The claw can be either held straight down, parallel to the tarsus, for walking on top of the web or turned in, almost perpendicular to the tarsus, for hanging under the web. There is also a small ridged area, at the base of the claw, which may aid in walking on top of the web or hanging from it.

The mirids did not try to avoid the spiders. They usually moved slowly across the web, their antennae moving up and down rapidly ahead of them in constant motion. One nymph was observed walking in front of an adult spider, less than one centimeter away, on the same side of the web. The spider took no notice of it. As reported by Worth (1967) in his observations on *Arachnicorus*, the nabids were in no danger of becoming stuck in dry silk webs. This was also true of the present spider-mirid association.

The hedge partially protected most of the webs from wind and rain, but the exposed part of the webs was badly damaged by these elements. The mirids moved to the part of the web back under the hedge when rain or wind started.

The insects were observed feeding on both plant and animal material caught in the webs. They fed both upright on top of the web and hanging inverted on the lower side with the beak inserted through the web. They were seen feeding on a variety of insects trapped in the webs or tied to it by the spiders. Some of the more common hosts included leafhoppers (Cicadellidae), katydid nymphs (Tettigoniidae), blow flies (Calliphoridae), and crane flies (Tipulidae).

It is likely that mirids killed and ate small insects without the spider's help. In one instance, several small flies were stunned and thrown on a web. One of the struggling flies was attacked by a mirid nymph. During the few seconds in which the mirid was fighting with the fly, the spider rushed to the scene, took the still struggling fly from the mirid, and returned to its funnel. After having seen mirids feeding on honeysuckle stamens, we placed a group of three stamens on a large web away from where any mirids were walking. Within 15 minutes, 8 mirids had gathered on top of the web and 7 on the bottom to feed on the stamens.

One possible predator was seen on a large web at night. This was a male club-footed spider (Clubionidae), several of which were seen to be active on several parts of the hedge throughout the night. The clubionid was seen on the underside of an agelenid web, along with several mirids, but apparently was scared off by the light.

Laboratory Studies

Materials and Methods

In the spring of 1968, mirid nymphs were collected by tapping the web over a small glass vial. They were reared using a method modified from that of Yonke and Medler (1964), being kept individually in the laboratory in small glass cages made of 38 mm diameter glass tubing, 50 mm high, the tops of which were covered with 0.1 mm mesh plastic screen. The cages were set on a 23 × 35 cm plastic box, filled with water, out of which 10 dental wicks projected, one for each of ten cages. The cages were placed in a Thelco Model 4 (Precision Scientific Co.) growth chamber at 30°C. ± 2°C., with a 15 hour light, 9 hour dark daily photoperiod.

Table 1. Duration (days) of the nymphal stadia of 20 *Ranzovius moerens** reared to maturity. (AfterWilkinson and Daugherty, 1967)

Stadium	Range	Mean ± s	Cumulative mean age
1*	2-7*	3.8 ± 1.06	3.8
2	3-6	4.0 ± 0.98	7.8
3	3-13	5.0 ± 1.60	12.8
4	3-16	5.4 ± 1.65	18.2
5	6-12	8.1 ± 1.34	26.3
Total nymphal period	22-36	26.3	
Adult female	28-56	41.3 ± 10.96	67.6
Adult male	1-18	7.8 ± 6.12	34.1

*Reared from 1st instar nymphs collected from webs. Time in stadium 1 began with day collected.

The nymphs for laboratory rearing were considered to be first instar for the following reasons: of 81 nymphs collected from the webs and measured, none was below the size range for the first instar given in Table 1; of the 43 considered to be in the first instar group, 32 were placed in cages for rearing, and none had more than five molts to reach maturity; it is unlikely that any time was spent off the webs since the insects were unable to stay upright except on the spider silk.

Both nymphs and adults had trouble walking on a flat surface; they fell onto their backs and were unable to right themselves. Since this led initially to many deaths, webbing was added to the cages by placing an immature spider in the cage and allowing it to spin a web. The spider was then replaced by a mirid.

Daily records were kept on the number of instars, number and time of molts, the time spent in each instar, adult longevity, and type of food used.

Food used in rearing both nymphs and adults was one or more of three types. Fruit flies, *Drosophila melanogaster*, were cultured and frozen at an earlier time, then thawed before being placed in the cages. Honeysuckle stamens were taken from the hedge where the mirids occurred. Abscissed avocado flower buds, also observed as food for the mirids in the field, were collected from a tree shading the hedge.

In an effort to corroborate Bristowe's (1941) statement that the flavor of many bugs renders them immune from attack by spiders, spiders and mirids were placed together in small cages provided with water and honeysuckle stamens to see if the mirids would be eaten. Eleven such trials were carried out, using first and second instar nymphs and immature agelenids.

Results

Nymphal Stages and Feeding Trials

Twenty nymphs were reared to maturity (Table 1), with measurement of nymphal development time starting on the day of collection. The average number of days spent in each instar was 3.8, 4.0, 5.0, 5.4 and 8.1 days, with completion of the entire nymphal development in an average of 26.3 days.

The males took an average of 25.6 days to complete their development while the females required an average of exactly 1 day more.

The effects of the diets on maturation are shown in Table 2. Females reared on avocado buds reached adulthood in an average of 29.3 days, 6 days longer than those fed on *Drosophila* only. A single

Table 2. Food used in rearing 20 *R. moerens* nymphs to maturity. Range, mean total nymphal period, and number reared is given for each food type.*

6	Drosophila (frozen) and	22-27	23.0

Nymphs	Food type	Range	Mean total nymphal period (days)
6	*Drosophila* (frozen)	22-29	24.5
7	Avocado flower buds	25-36	31.1
5	Honeysuckle stamens	22-27	24.8
2	*Drosophila* (frozen) and Honeysuckle stamens	22-24	23.0

*Fruit flies, *Drosophila melanogaster*, were cultured, frozen, then thawed before feeding to bugs. Honeysuckle stamens and avocado buds were collected from the study area, where they were seen being fed upon by the bugs.

female reared on a mixture of honeysuckle stamens and *Drosophila* matured like the latter group. Four males reared on avocado buds matured in an average of 32.5 days. The average was 27 days for the 2 fed *Drosophila* and 24.8 days for the 5 using honeysuckle stamens. The single male fed a mixture of the flies and honeysuckle matured in 22 days. The resulting adults were maintained on one of the three dietary regimens on which the nymphs were reared. The 8 females lived for an average of 41.3 days, while the 12 males survived for an average of only 7.8 days. The females lived for an average of 41 days on avocado buds and 44.5 days on *Drosophila*. The males averaged 12 days on Drosophila, 8.6 on honeysuckle and 5 days on avocado. The longest lived specimen was a female, reared on flies, which lived a total of 80 days; 56 of them as an adult.

On two occasions, adult female spiders were put in a dish to spin a web for rearing mirids. The webs were in poor condition, but egg sacs were constructed in the corner of each dish. The female spiders spent about 80% of their time sitting on the egg sacs, apparently guarding them. To see if the mirids would feed on these eggs, the spider was removed and one adult and two nymphal mirids were placed in each of the two dishes. No other food was added, but a wick was provided for moisture. The mirids were never observed feeding, although from time to time they would walk across the egg sacs. All had died within a week.

Spider Prey

In the eleven trials using first and 2nd instar nymphs in cages with immature spiders, the mirids lived for an average of 4.4 days (range 2-10 days) before being killed or eaten (eaten 9 of 11 times). Two

of these were repeat trials using spiders that had eaten one bug previously, but in both cases the mirid lived only 5 days before being eaten.

Discussion

The time from the first appearance of nymphs to the first appearance of adults in the field was 70 days in 1967, and 46 days in 1968; this compared to an average laboratory development time of 26.3 days (range 22-36 days). It seems likely that growth, after hatching in early spring, is retarded by climatic conditions and/or lack of food. The first nymphs appeared before the hedge started to bloom, and the supply of insects caught in the webs was very low. As the warmer weather arrived, the hedge started to bloom and, in addition to dropping stamens in the webs, the flowers attracted a greater number of insects to the spiders' webs. The last of the first instar nymphs were seen in the field in early June and had developed to adults by the end of June. This period of less than 30 days agrees more closely with the laboratory rearing data.

Field and laboratory data agree in general on adult longevity. The period from the time the last nymph had reached maturity to the time the last adult was seen was 70 days in 1967, 60 days in 1968. Laboratory longevity for female adults averaged 41.3 days (range 13-56 days).

Only one generation occurs in this locality per year and indirect evidence indicates that overwintering occurs in the egg stage. No adults were seen in the early spring and nymphs and adults were absent from the webs from early September to mid March of the following year. Dispersal may occur in the fall, since flying was observed in the laboratory.

As previously stated by Bristowe (1941) for another arachnophilous bug, the large numbers of first instar *Ranzovious moerens* in the webs indicated that the eggs are laid in or near the webs. Since female adults possess a fully developed ovipositor, it can be further assumed that the site of oviposition was plant tissue in or near the webs.

Field observations and laboratory rearing showed that the mirids are relatively omnivorous, eating both plant and animal material. Laboratory rearing studies confirmed this when the bugs passed through five molts to maturity when fed on either of two plant sources or the insect host. The type of food used for rearing affected both the time to mature and the adult life span. Both males and females took over 5 days longer, on the average, to mature when reared on

avocado buds than on either of the 2 food sources which occurred most frequently in the spider webs. The adults' life expectancy was lowest on avocado buds also; being more than halved in the case of the average male. There appeared to be little difference in the utilization of *Drosophila* or honeysuckle by either nymphs or adults.

The spider-mirid relationship appeared to be a case of commensalism, since from all indications, the mirids neither damaged nor benefited the spiders but obtained food killed by the spider or caught in its web and were provided by the spider with a substrate which afforded some protection from rain and wind as well as from predators. According to Carvalho (1954), *Ranzovius fennahi* in Trinidad was predacious on spider eggs. There are several indications that such a predacious habit did not occur with *R. moerens*: the small number of eggs laid by one agelenid spider compared to the large number (up to forty) of mirids observed in a single web, the tending of the egg sac by the spiders, and the observed feeding of the mirids on other food and not on the egg cases.

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